U.S. Department of Agriculture
Office of the Secretary

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THE OUTLOOK FOR SCIENCE AND EDUCATION CAREERS:

Texas Tech Seminar

Young people who earn college degrees in food and agriculture during the 1980's can look forward to a strong job market and vast professional challenge.

Most of today's high school and college students are being told that they must lower their professional sights. The "baby boom," they are told, has saturated the job market, and reduced their professional prospects.

Happily, a SEA-sponsored task force studying the supply and demand for graduates in the 1980's finds no such problem in food and agriculture. The task force has concluded that trained professionals will be scarce in most food and agriculture specialties in 1985-6. Especially scarce will be graduates with advanced degrees and those with practical farm or agribusiness experience to back up their academic credentials.

Food and agriculture professionals will also face plenty of challenge in the years ahead.

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Remarks by ~~Anson R. Bertrand~~, Director, Science and Education, U.S. Department of Agriculture, at a seminar on science and education at Texas Technological University, Lubbock, Texas, ~~May 30, 1980.~~

Andre and Jean Mayer wrote in 1974, "Few scientists think of agriculture as the chief, or the model science. Many, indeed, do not consider it a science at all. Yet it was the first science -- the mother of sciences; it remains the science which makes life possible, and it may well be that before the century is over the success or failure of Science as a whole will be judged by the success or failure of agriculture."1/

I wholeheartedly agree with that statement. Everything I see convinces me that agricultural science and education will be as exciting and rewarding -- and fully as important to the world -- as any area of opportunity in the years ahead.

New Productivity Needed

The world's population is increasing rapidly and bidding for a high standard of eating.

We cannot satisfy the needs and wants of tomorrow's population on the resource base and productivity we have today. We are no longer getting the big increases in crop yields and animal output that we experienced -- and perhaps took for granted -- in the 1940's, 50's and 60's. Productivity is plateauing not only here but in other countries around the world.

Soil erosion has reemerged as a major problem; our water constraints may very well be even more serious than land availability in the future; energy will continue more expensive - and less certain - for the foreseeable future.

1/ Mayer, Andre and Jean, "Agriculture: The Island's Empire," in Science and Its Public: The Changing Relationship, Daedalus, Summer 1974, pp 83-95.

More Knowledge Needed

There is also a crucial need for more knowledge in the areas of food safety, quality and healthfulness. We need to find rapid, accurate and economical ways to test the safety of chemicals, and to detect residues. We need better understanding of the impacts of diet on human health. We need more economical ways to preserve foods without additives, without altering fresh flavors, and with minimal amounts of energy.

More Sophistication Needed

Tomorrow's challenges will be more sophisticated and demanding. For example, where yesterday's farmer sprayed insecticides on a set schedule, today's farmer uses an integrated pest management approach--a systems approach that includes biological controls, resistant plant varieties, and insect monitoring along with highly-selective chemicals in limited amounts and with precise timing. Where yesterday's plant breeder crossed various strains of one species, tomorrow's may use surgical techniques and recombinant DNA to cross plant families.

Tomorrow's agricultural professionals will need even more sophisticated and demanding technology to overcome production constraints.

More Research, More Education Needed

Research and education are the only effective weapons with which we can meet the challenges that are ahead. Research and education are investments in the future. They are the way to expand our resources, both physical and human.

Investments in research in food and agricultural science are likely to continue to pay handsome returns -- both to the people who follow these career paths and to the public at large. Several recent studies have shown that investments in research pay 30-90% annual return, with the average being near 50%.

New research frontiers and opportunities abound. Newly discovered principles and methods will help us to better understand basic biological processes -- and our improved understanding will help us to control the mechanisms and functions of living cells. We will be able to breed vastly more productive crops and livestock, to control diseases and pests, to improve the quality of farm products and maintain that quality through processing and marketing stages, and to provide even better nutrition for consumers.

If we can find ways to control photorespiration and to channel that wasted energy into useful products instead, we can sharply increase the productivity of many plant species.

We have made very significant progress in understanding the process by which genetic messages are carried from one generation of organisms to another, through the DNA chain. Soon we will be able to modify those messages. Opportunities for altering organisms and building in desired characteristics are exciting indeed. Already recombinant DNA work has brought us close to a safe and economical vaccine against foot-and-mouth disease. And in the long run, we may be able to manipulate genetic material to achieve major improvements in plants and higher animals. Thus we could have plants and livestock with built-in immunity to disease and pests. Animals with vastly more efficient feed conversion capabilities, a more desirable lean-fat ratio and even a higher proportion of desirable cuts.

Recombinant DNA work also has the possibility of being able to give corn and sorghum nitrogen-fixing properties of legumes. Just consider how much energy we could save by drastically reducing the need for hydrocarbon-based fertilizers.

If we really understood the role of nutrients at the cell level, and thus the inter-relationships of animal feed components we could increase feed conversion. It might even permit the use of new feed sources that would not compete with food for direct human consumption.

We have opportunities for altering agricultural production methods so that farming becomes a net producer of energy instead of a consumer -- without sacrificing food production or export earnings. The whole area of biomass production and conversion through fermentation is opening new opportunities for research and education. Materials that can be used for fuel alcohol, with the fermentation residue becoming an important feed component are numerous and plentiful.

These possibilities illustrate the exciting potential of careers in food and agriculture. And the nation is going to need more people to take up those careers than we now project will do so.

Right here in Texas the Department of Agriculture is establishing a new laboratory to study the serious problem of how to make better use of scarce water for crops in arid areas. We know that a lack of moisture puts stress on plants and cuts yields. We invented irrigation as a way to prevent that stress. But irrigation water gets less abundant and more expensive with every revolution of the irrigation pumps -- and with every meeting of the OPEC oil ministers.

The new laboratory will focus scientists from many different specialties on cutting water evaporation from the soil, breeding plants that use water more efficiently or tolerate more stress without loss of yield, and on new materials, treatments, or cultural practices that will increase our efficiency of water usage.

We are working to produce complete -- and completely balanced -- protein in soybeans, peanuts, and cowpeas, which are used both as human foods and as livestock feeds all around the world. Recombinant DNA seems to hold some real promise here too.

We are trying to develop new crops which could produce important amounts of hydrocarbons in very arid regions. This could raise overall agricultural productivity in this country, and at the same time help cut down on oil import needs.

We are continuing vitally important "defensive" efforts, such as breeding disease-resistant plants, and staying ahead of the insects and weeds which are developing resistance to our currently-used pesticides.

It may be possible to breed a much better range of plants than we have been able to produce before. We are exploring surgical and chemical techniques to get fertile offspring from "wide crosses" that leap over natural genetic barriers. We have already developed several new hybrid cottons using wild and domestic strains which normally cannot cross. And we are exploring such inter-family crosses as pearl millet and sorghum. These techniques would permit us to draw on a far wider genetic base, with the possibility of productivity breakthroughs. We might get more drought-tolerant wheat, for example.

Agricultural engineers face the challenge of making tomorrow's equipment more energy-efficient. But they can draw on emerging technology in solar conversion, photo-voltaic cells, and micro-computers to achieve their results.

Even the education field is facing a revolution brought on by computers and electronic communications.

Tomorrow's Opportunities in Science and Education

Most U.S. students today face a congested job market. Top-caliber jobs will be hard to get, and promotions will come slowly. But in food and agriculture, we foresee relatively strong demand for graduates at all levels -- from associate degrees right on up through the PhD. The demand will be especially strong for those students who put forth the effort and investment to get advanced degrees. Such people will be in short supply virtually across the spectrum of food and agriculture. Students who combine advanced degrees with practical experience in agriculture or related industry will be the most sought-after of all.

Basis of Projections

A study sponsored by the Science and Education Administration has recently completed projections on the number of food and agriculture graduates that will be available in 1985-86, and of the demand for such graduates.

Information on the supply of higher education graduates likely to enter the job market was obtained from the Higher Education General Information Surveys of DHEW's National Center for Education Statistics. This is the most comprehensive source of data covering the output of higher education programs in this country.

Occupational demand information came from the Occupational Employment Statistics Program of the Bureau of Labor Statistics -- a BLS matrix cross-classified by industry and occupation. This is based on OES-Census information plus monthly surveys.

These data bases were supplemented by cooperation from the National Science Foundation, the Department of Defense, the AVA and other sources of information.

Two special surveys were also undertaken: one of faculties in food and agricultural sciences in higher education institutions, and another covering international agricultural employment opportunities for Americans. These surveys filled critical gaps in existing data.

The various data sources were synthesized into a single analytical model with the help of a panel of consultants from Colleges and Universities. Essentially this panel was composed of directors of resident instruction; people who have built careers helping students make career choices and assisting in job placement.

The results of the study reports demand under the following categories: (1) scientific and professional specialists; (2) manufacturing and processing scientists and engineers; (3) sales and service representatives and purchasing agents; (4) administrators, managers and financial advisors; (5) agricultural educators; (6) agricultural media; (7) agricultural production and management specialists (primarily farming and ranching); and (8) a miscellaneous category that includes such specialties as farm implement mechanics and food service supervisors.

Let me give you a run-down category by category.

Scientists and Professional Specialists:

The study concluded that there would be a particular short supply of masters and PhD. degree holders in such fields as plant and animal science, agricultural engineering, agricultural economics, food science, nutrition, and veterinary medicine (especially pathologists and toxicologists).

Manufacturing and Processing Scientists and Engineers:

The current demand for these specialties already exceeds the supply, especially in the engineering areas. The study projects continued demand for energy efficiency, quality control and improved alternative food sources will further escalate needs.

For the extended future, we expect strong demand for agricultural engineers at all degree levels, food and plant scientists at the Ph.D level, and veterinarians. They also foresee strong demand for specialists in the paper and wood products utilization industries.

Sales and Service Representatives and Purchasing Agents:

Sales and service representatives will continue to play a key role in delivering technology to farmers and ranchers. They will probably become even more important to their companies in marketing to increasingly sophisticated customers. Holders of baccalaureate degrees who combine a technical field with business and marketing training will be in a strong position to compete for these opportunities.

The coming years will probably see a continued increase in the number of meals eaten outside the home -- which will expand the number of jobs for associate and baccalaureate degrees in food technology and food science.

Administrators, Managers and Financial Advisors

The demand will be particularly strong for financial managers and administrators in public agencies.

The study predicts an extensive shortage of people who combine a master's degree in agricultural economics with financial analysis and management skills.

Demand is also expected to be good for appraisers and estimators to help in evaluating alternative land uses. They will need to have expertise in soils, plants and natural resources as well as applied economics.

Would-be managers should make it a point to combine their technical studies with training in business and management.

Agricultural Educators:

The projections do not indicate a general shortage of trained high school teachers for the mid-1980's. Of course there has seldom been a shortage of graduating numbers in this field, but there seems to be a chronic shortage of people to take these jobs -- because the ranks of teaching graduates are "raided" by other professionals.

In addition, a recent Ohio State University study indicated an annual shortage of 600-750 vocational agriculture teachers nationwide -- each year -- because of teachers hired away by other sectors.

The report also predicts an above-average number of faculty retirements in the 1980's, the result of the big post-World-War II expansion in food and agriculture faculties. Academia will be seeking more holders of masters and Ph.D degrees for teaching and research positions.

Regional factors will be important in the teaching field, because some will have expanding enrollments while other sections of the country will have fewer students enrolled in the food and agriculture fields.

Overall, there appears to be a strong and continuing demand for food and agriculture graduates through the 1980's. In the near term, the strongest needs will be for doctoral graduates in agricultural engineering, agricultural economics, agronomy, veterinary medicine and in specialty areas of animal science such as poultry science.

Agricultural Information Specialists:

This is the only major area where the projected supply of graduates appears to meet demand. Regional farm publications and government agencies will be the largest employers, followed by agri-business firms and commodity organizations.

Agricultural Production and Management Specialists:

The projected demand for farm and ranch managers will be slightly smaller than now, due to continued increases in the size of production units. However, these managers will need to be better trained. There will be more confinement feeding operations for hogs and cattle, more complex technology for crops and a generally higher level of sophistication. That means more highly trained managers with associate, baccalaureate and master's degrees. The strongest demand will be for graduates who combine these degrees with practical experience.

Miscellaneous Agricultural Specialists:

A substantial shortfall is projected in some of the highly-skilled specialties associated with agriculture, such as farm implement mechanics, graders and meat cutters.

Increased requirements for food and safety and quality and increased demand for more convenience foods should augment the demand for associate and baccalaureate degree holders in food technology.

The major warning note sounded by the task force was in the occupations associated with parks, forests and recreation enterprises. The task group noted that a large supply of graduates is currently in the field, and a depressed market for these workers may develop in the coming decade.

International Employment Opportunities in Food and Agriculture

The demand for food and agricultural scientists extends beyond the borders of the U.S., and the American agricultural education system is highly regarded. A special survey of the USDA's Foreign Agricultural Service indicated some expected growth in this area, but the numbers are not large. Total expected needs in 1985-6 were less than 2000 workers. The current and future areas of greatest need are agricultural business and management, agricultural education, agricultural engineering, plant sciences and natural resource management.